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None

(58) Field of search
A5A
Selected US specifications from IPC sub-class
A62C

(54) Combination thermal actuator and fusible link, especially for fire and/or smoke dampers

(57) A combination thermal actuator and fusible link comprising a memory metal spring (16) adapted to change its shape on a rise in temperature and a fusible link (spindle 10 and latching bush 12) incorporating fusible material adapted to melt at a predetermined higher temperature, the arrangement being such a change in the shape of the memory metal spring (16) due to a rise in temperature and/or fusing of the fusible material causes the spindle or shaft (10) to make an axial actuating movement. The actuator may alternatively incorporate an anti-vibration locking device, be arranged in a unitary structure which can be mounted outside a duct containing a fire and/or smoke damper with which the actuator/link is associated or be in the form of a cartridge which can be mounted at one end on the blade actuator of a fire and/or smoke damper.

Fig.2.

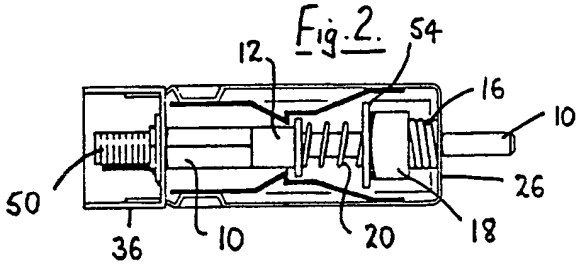

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Fig.1.

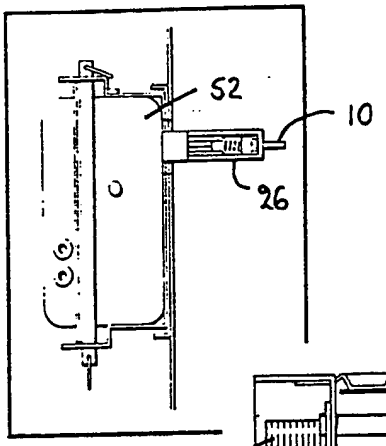


Fig.2.

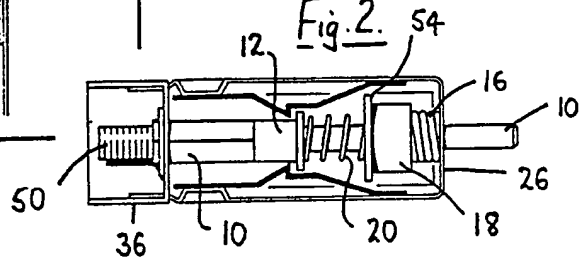


Fig.3.

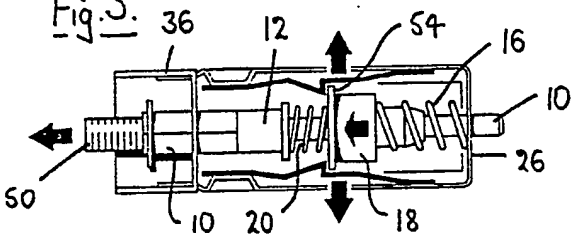


Fig.4.

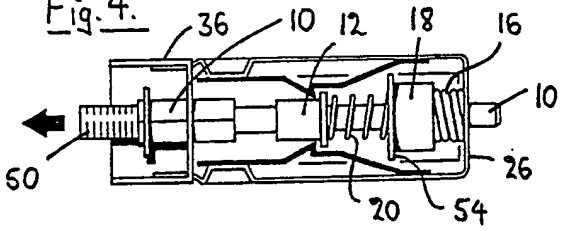
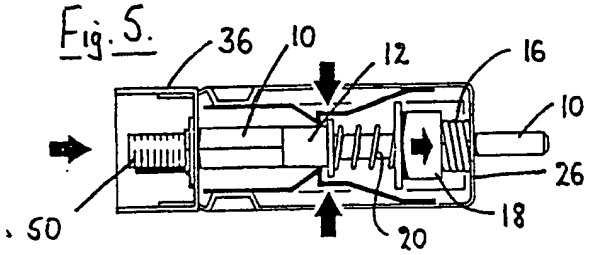


Fig.5.



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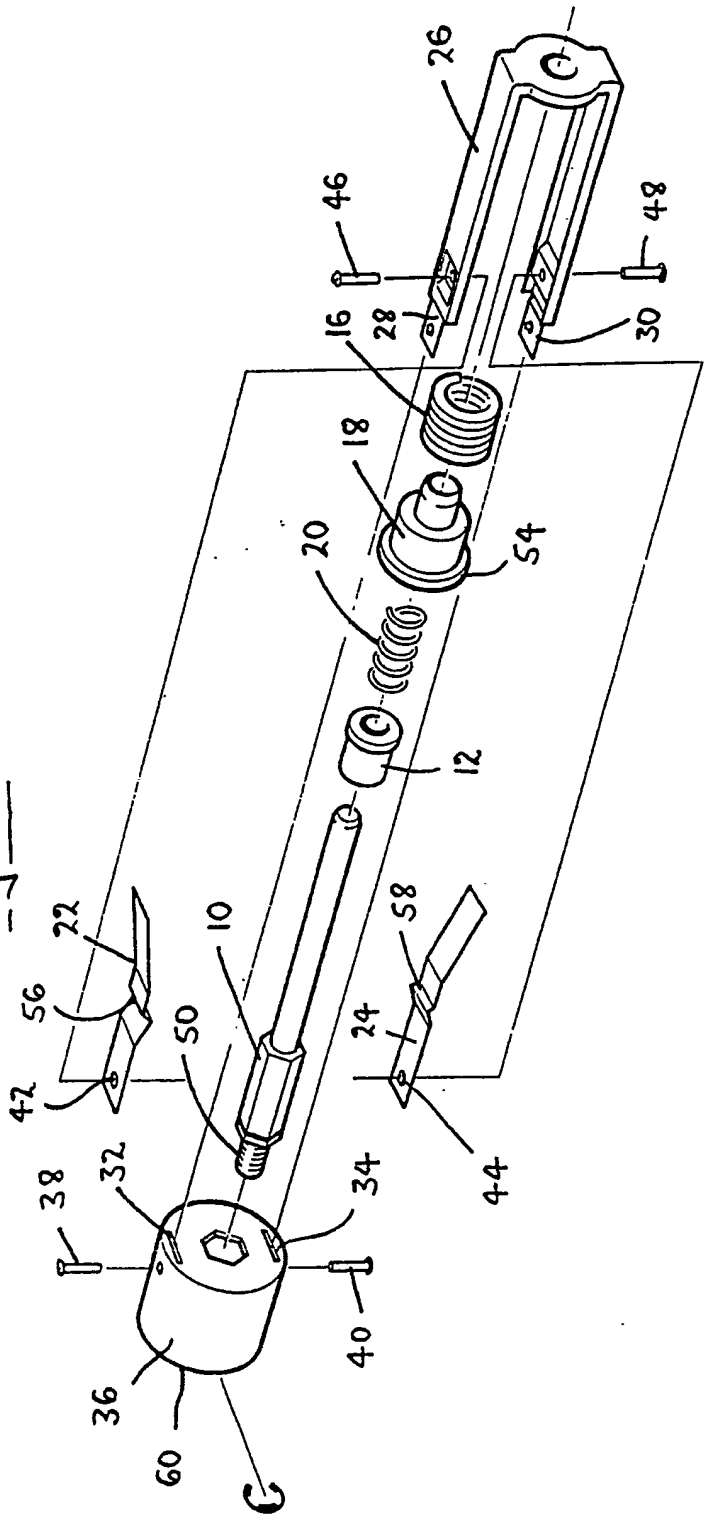

Fig. 6.

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Fig. 7.

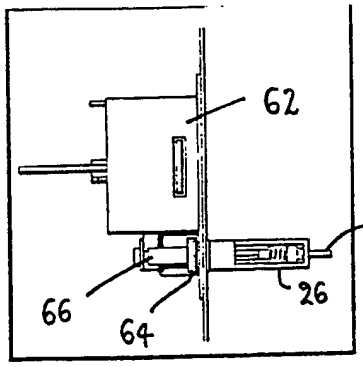


Fig. 8.

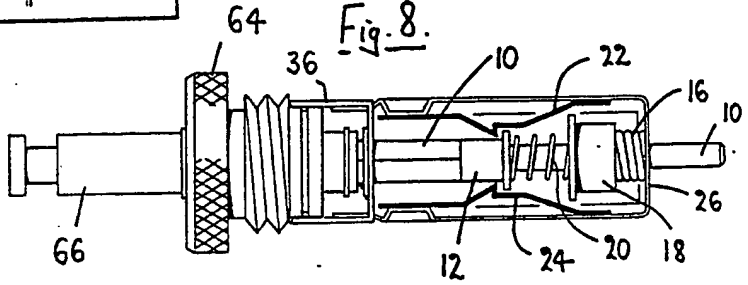


Fig. 9.

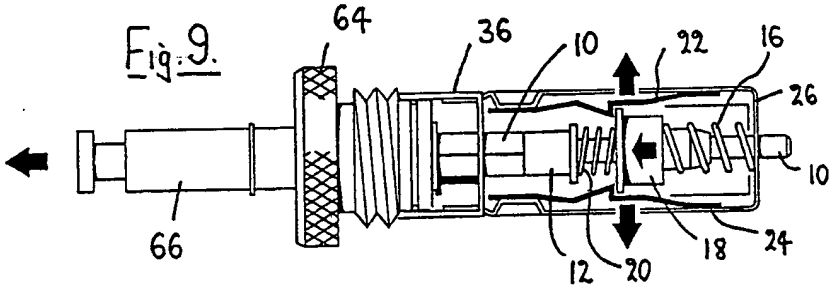


Fig. 10.

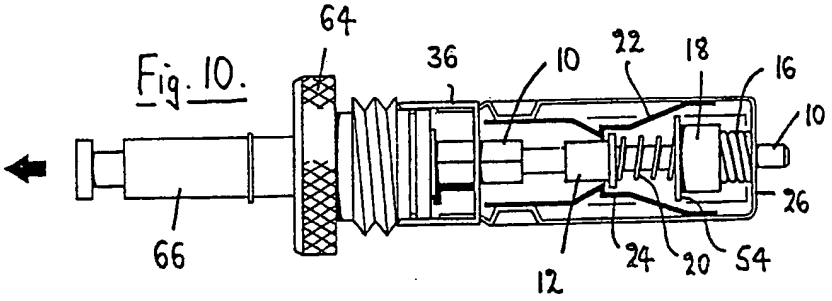
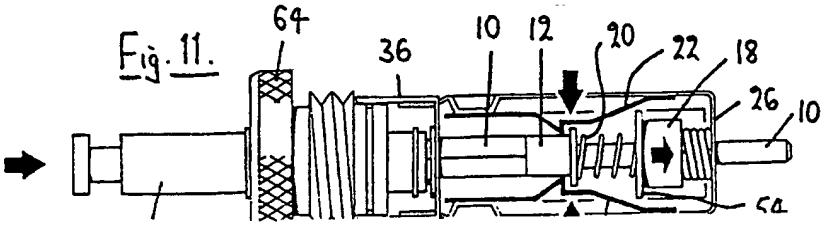


Fig. 11.



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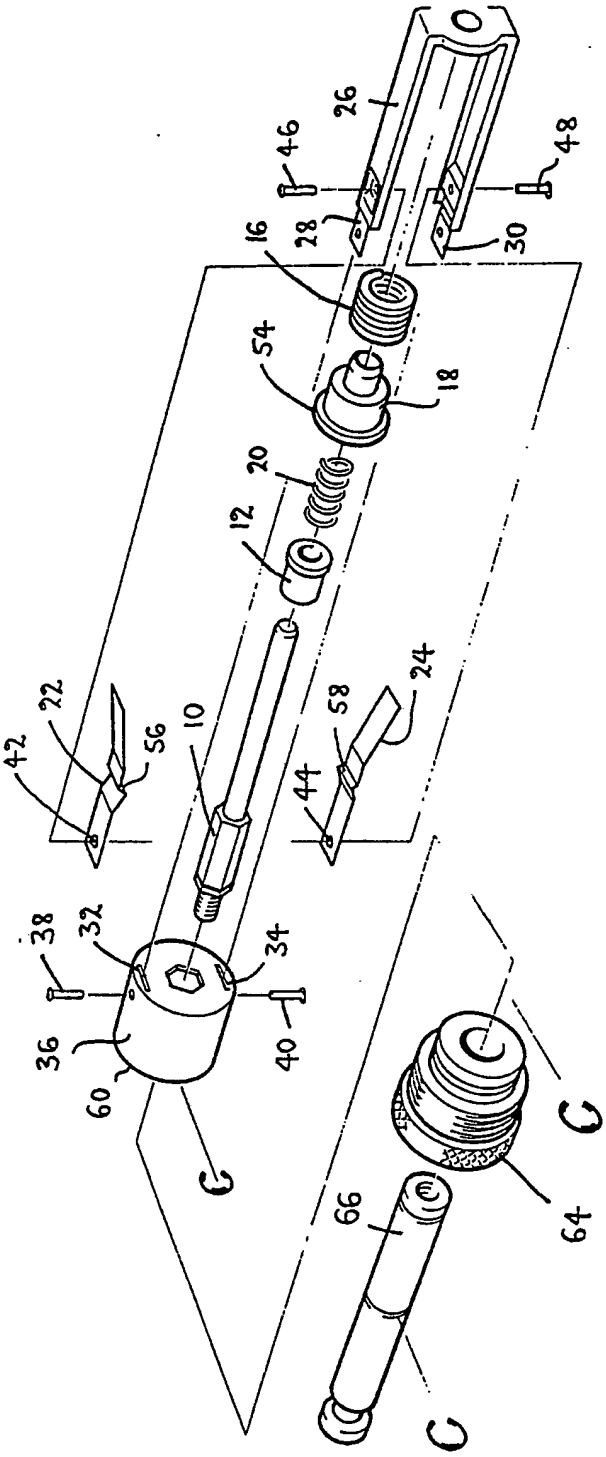

Fig. 12.

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Fig. 13

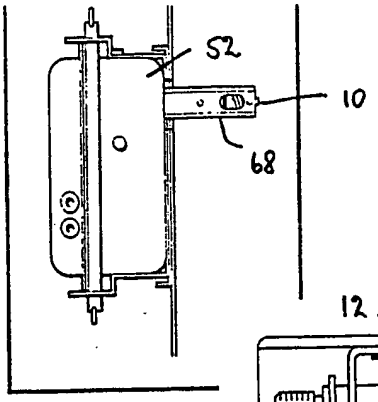
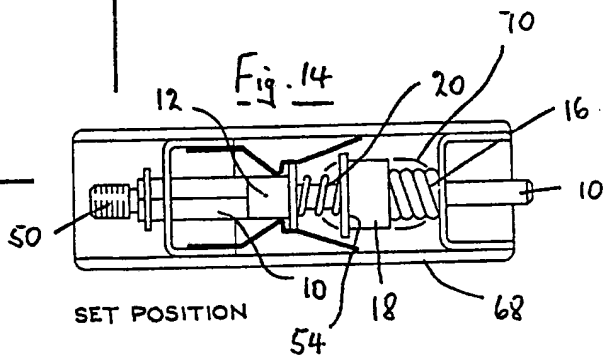
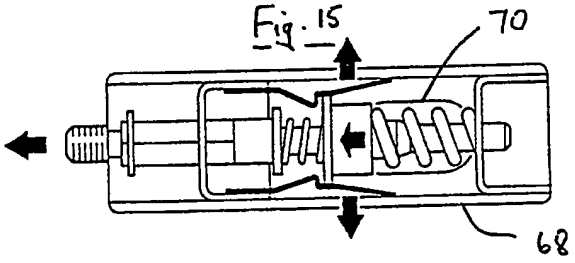


Fig. 14



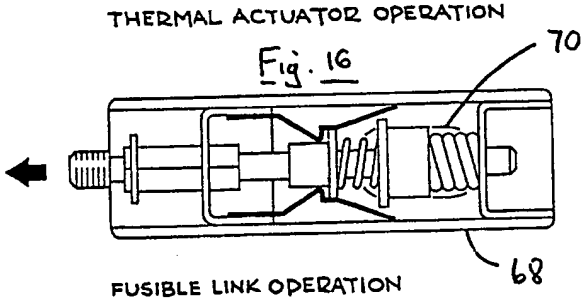
SET POSITION

Fig. 15



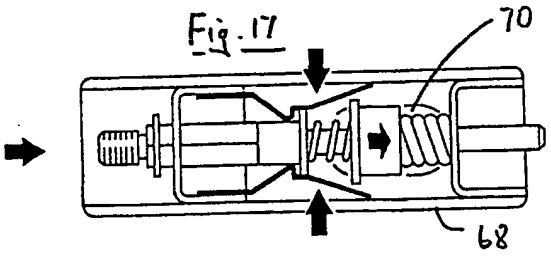
THERMAL ACTUATOR OPERATION

Fig. 16



FUSIBLE LINK OPERATION

Fig. 17



RESET POSITION

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Fig. 18.

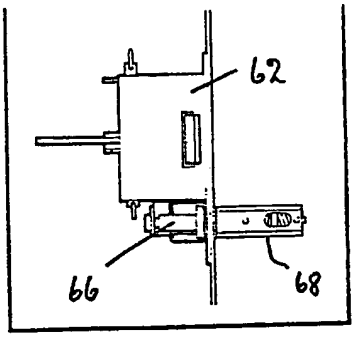
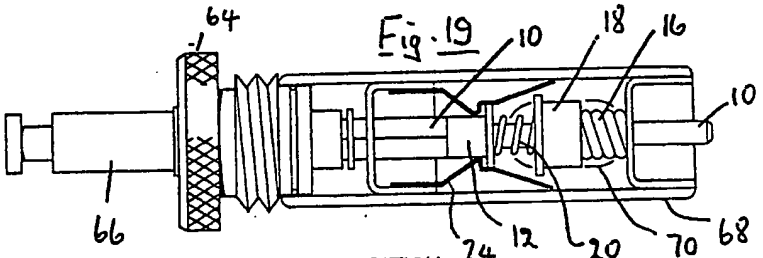
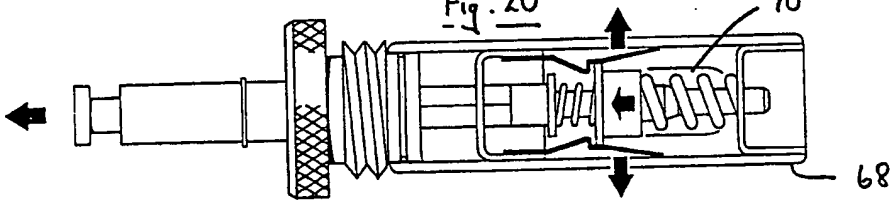


Fig. 19



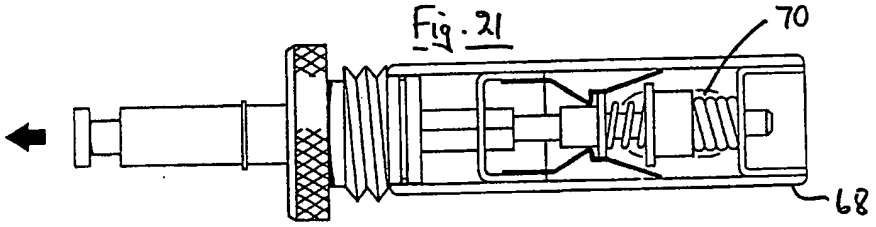
SET POSITION

Fig. 20



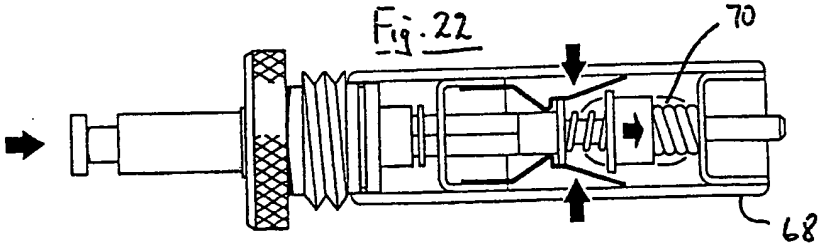
THERMAL ACTUATOR OPERATION

Fig. 21



FUSIBLE LINK OPERATION

Fig. 22



RESET POSITION

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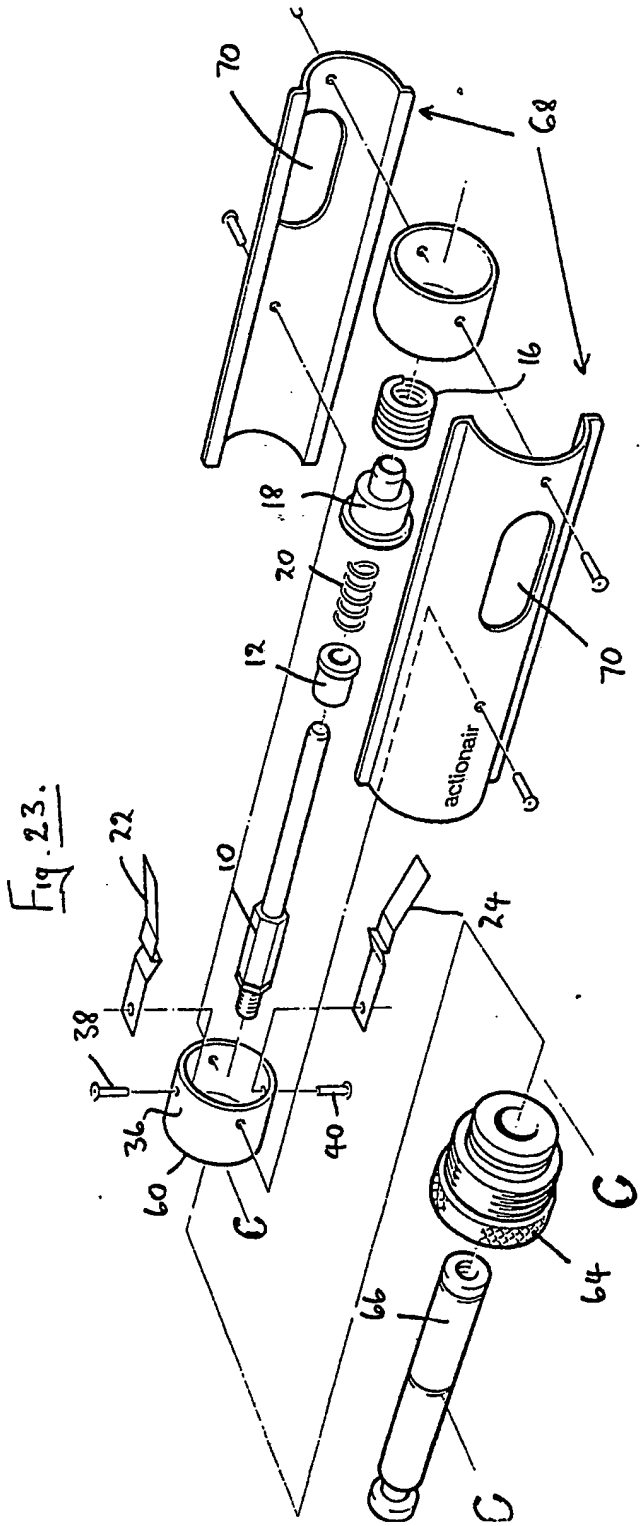

Fig. 23.

Combination Thermal Actuator and Fusible Link, especially for Fire and/or Smoke Dampers

This invention relates to a combination thermal actuator and fusible link, especially for fire dampers, smoke dampers and combination fire and smoke dampers as used in the ducts of ventilation systems installed in buildings or ships.

In our prior British Patent No. 2,108,629B we have described a spring-powered actuator for operating devices such as fire and/or smoke dampers, doors, hatches, vents, traps, valves and other devices having components which are movable between at least two positions (usually a closed position and an open position). As described in that Patent, the spring-powered actuator is said to be particularly advantageous when used in combination fire and smoke dampers of the kind having inter-locking aerofoil blades arranged for swivelling movement about parallel axes into and out of a position in which they close a through-passage in the damper.

Mounted on the box of the spring-powered actuator described in that Patent is a fusible element which comprises a shaft having a screw-thread which permits it to be screwed into the box of the actuator. Carried on the shaft are two interfitting cover portions which are soldered or otherwise connected together by a fusible

metal. Accordingly, when the temperature in a duct containing a fire and/or smoke damper which is operated by the actuator rises above a certain predetermined level the solder or other easily melted metal holding the two cover portions together will melt, thereby allowing the two cover portions to fly apart. This then causes a lead screw forming part of the spring-powered actuator to be released so that the spring of the actuator acts to rotate the blades of the damper into their closed positions.

In another prior British Patent No. 2,121,531B, we have described a fire and/or smoke damper which likewise has an actuating mechanism provided with a fusible element. This fusible element is of substantially the same construction as that illustrated in Patent No. 2,108,629B mentioned above, but its connection to the actuating mechanism is a little different. Thus, in Patent No. 2,121,531B, the two interconnected cover members or portions of the fusible element are releasably attached to a fork lever of the actuating mechanism which is loaded by a spring so that the lever is held in a particular position of rest. The fusible element projects into a duct containing the damper so that, when the temperature within the duct rises above a predetermined level, the fusible metal in the fusible element melts and allows the two cover members or portions to move apart, thereby giving the shaft of the fusible element freedom to move axially under the

action of the above-mentioned spring. This in turn allows the fork lever to trigger another lever in the actuating mechanism so that the blades of the damper are rotated into their closed positions.

We have recently taken the use of such fusible elements in dampers a stage further by producing and marketing a combination thermal actuator and fusible link for use in fire and/or smoke dampers so as to provide dual fail-safe operation. This form of combination thermal actuator and fusible link is described in our British Patent Application No. 2,180,745A and is of a unique construction. In one specific form of device which is shown and described in the said Patent Application and which we have put on the market, the thermal actuator has a helically-coiled memory metal compression spring produced from a special Cu-Zn-Al brass alloy which is formulated to give a transformation (start to move) temperature at 40° C. so that the spring will then expand from its close-coiled state and become open-coiled at approximately 72° C. This causes the blades of a fire and/or smoke damper with which the device is associated to be closed by an appropriate actuating mechanism. On cooling, the spring reverts to its close-coiled state, thereby offering the significant advantage that the thermal actuator can operate repeatedly without degradation or loss of memory of the spring unless it is subjected to temperatures in excess of 180° C.

The thermal actuator therefore controls the fire and/or smoke damper in those frequently-encountered situations where there is a temporary rise in temperature in a duct without resort to fusing of the fusible link with its consequent replacement cost. On the other hand, the provision of the fusible link ensures that, if the temperature rises to about 200° C. or above, the device will act - through melting of the fusible metal in the link - to cause the blades of the damper to be rotated into their closed positions. The combination thermal actuator and fusible link thus provides for dual fail-safe operation in a full fire condition.

The present invention constitutes a further step along the path mapped out above and is directed broadly to a combination thermal actuator and fusible link which is so constructed as to be usable in place of the fusible links shown in our British Patents Nos. 2,108,629B and 2,121,531B.

From another aspect, the invention is directed to a combination thermal actuator and fusible link having a spindle or shaft provided with a helically-coiled memory metal spring which, on expansion due to a rise in temperature, ensures axial movement of the spindle or shaft.

From another aspect, the invention relates to a combination thermal actuator and fusible link having an

anti-vibration locking device.

The invention also extends to a combination thermal actuator and fusible link which is adapted to be re-set from outside a duct containing a fire and/or smoke damper with which the actuator/link is associated.

Four examples of combination thermal actuators and fusible links in accordance with the invention are shown in the accompanying drawings, in which -

Figure 1 is an outside view of a damper actuator of the construction shown in our British Patent No. 2,108,629B with a combination thermal actuator and fusible link mounted on it;

Figures 2-5 are enlarged sections through the actuator/link shown in Figure 1 at different stages in the operation of the latter;

Figure 6 is an exploded perspective view of the actuator/link shown in Figures 2-5;

Figure 7 is an outside view, similar to Figure 1, of a damper actuator of the construction shown in our British Patent No. 2,121,531B with a combination thermal actuator and fusible link in accordance with the present invention mounted on it;

Figures 8-11 are enlarged sections, similar to those shown in Figures 2-5, through the actuator/link shown in Figure 7;

Figures 12 is an exploded perspective view, similar

to Figure 6, of the actuator/link shown in Figures 8-11;

Figures 13-17 are views corresponding to Figures 1-5 of another form of actuator/link; and

Figures 18-23 are views corresponding to Figures 7-12 of yet another actuator/link.

The combination thermal actuator and fusible link shown in Figures 1-6 comprises a fusible link spindle 10 which carries a fusible link latching bush 12. The bush 12 is secured against axial movement on the spindle or shaft 10 by being soldered thereto, while a helically-coiled memory metal "spring" or thermal actuator 16 surrounds a rear portion of the spindle or shaft 10. Mounted for limited axial movement on the rear portion of the shaft or spindle 10 is a thermal actuator plunger 18 which is separated from the fusible link latching bush 12 by a thermal actuator plunger bias spring 20. Lying on opposite sides of the spindle or shaft are two release/stop latch springs 22 and 24 while a yoke 26 extends forwards from the rear portion of the shaft or spindle 10 so that forward tongues or lugs 28 and 30 on the yoke enter respective slits 32 and 34 on an anti-vibration cup 36 to which the tongues or lugs 28 and 30 are secured by pins 38 and 40 respectively. The latch springs 22 and 24 each have a small hole 42, 44 near one of their ends so as to be pinned by pins 46 and 48 respectively to a rear portion of the yoke 26.

The forward portion of the spindle or shaft 10 is provided with a screw-thread 50 which permits it to be screwed into the box 52 of the actuator shown in Figure 1. As thus mounted, the various parts of the combination thermal actuator and fusible link will take up the positions shown in Figure 2. If, now, the temperature rises to, say, 70° C., the close-coiled memory metal spring 16 will expand axially of the shaft or spindle 10 as shown in Figure 3 so as to move the thermal actuator plunger 18 to the left. A radially projecting flange or rim 54 on the plunger 18 thereby forces the latch springs 22 and 24 outwards as shown in Figure 3, with the result that shoulder portions 56 and 58 on the latch springs 22 and 24 are moved clear of the fusible link latching bush 12. The latching bush 12 accordingly moves axially to the left, taking the spindle or shaft 10 with it, thereby causing the shaft to initiate operation of the damper actuator 52. The actuator thereby rotates the blades of the damper into their closed positions in response to the temperature rise detected by the memory metal spring 16.

The combination thermal actuator and fusible link can subsequently be restored to its re-set position - shown in Figure 5 - by axial movement of the spindle or shaft 10 to the right. The various parts of the actuator/link will then take up the positions which they had in Figure 2. However, no degradation or loss of memory of the memory

metal spring 16 will have occurred, nor will the fusible link itself have been involved in operating the blades of the damper. In other words, the cost of replacing the fusible link will have been avoided.

Nonetheless, should the temperature in the duct containing the damper rise to, say, 200° C, or above, the fusible metal bonding the fusible link latching bush 12 to the spindle or shaft 10 will melt so as to allow the shaft or spindle to move to the left - without the latching bush 12 - as shown in Figure 4 of the drawings. Such axial movement of the shaft will initiate operation of the actuator in the same way as in Figure 3 of the drawings where axial movement of the spindle or shaft was caused by expansion of the memory metal spring 16.

If desired, the forward edge 60 of the anti-vibration cup 36 can be of serrated or wavy form so as to bite on to its mounting on the actuator box 52. It is also to be noted from Figure 1 that the combination thermal actuator and fusible link is mounted on the outside of the box so as to be easily resettable from outside the duct containing the damper.

The combination thermal actuator and fusible link shown in Figures 7-12 is essentially of the same construction as that shown in Figures 1-6, and the like parts have been designated by the same reference numerals. The actuator/link shown in Figures 7-12 differs from that

shown in Figures 1-6 in that a nut 64 and a shaft extension 66 are provided to permit the actuator/link to be mounted on the actuator 62 as shown in Figure 7.

Operation of the combination thermal actuator and fusible link shown in Figures 7-12 is the same as that illustrated in Figures 1-6, as will be clear from a comparison of Figures 8-11 with Figures 2-5. In other words, Figure 8 represents the set or rest position of the actuator link, Figure 9 illustrates its operation when the memory metal spring 16 expands, Figure 10 illustrates operation of the actuator link when the fusible metal melts, and Figure 11 represents the re-set or restored position corresponding to Figure 5.

Figures 13-17 and 18-23 show two further actuator/links. Parts in these two links which are identical or similar to corresponding parts in Figures 1-6 and 7-12 have been given the same reference numerals so that further description of them is believed to be unnecessary.

The essential difference between the actuator/link shown in Figures 13-23 is that the yoke 26 in the earlier Application has been replaced by a split barrel 68 - see Figures 23 - which serves to protect the various parts of the actuator/link from corrosion and the ingress of dirt. A window 70 is however provided in each half section of the barrel 68 to permit a through-flow of air and to enable a

visual inspection to be made of the memory metal spring 16. Apart from this, the actuator/links shown in Figures 13-23 function in the same way as those described in the preceding Figures.

It will thus be seen that the invention provides for dual fail-safe operation of the blades of a fire and/or smoke damper. It also avoids unnecessary melting of the fusible metal when the temperature in the duct rises temporarily.

Claims

1. A combination thermal actuator and fusible link comprising a memory metal spring adapted to change its shape on a rise in temperature and a fusible element or fusible material adapted to melt at a predetermined higher temperature, the arrangement being such that a change in the shape of the memory metal spring due to a rise in temperature and/or fusing of the fusible element or fusible material causes a spindle, shaft or equivalent member to make an axial actuating movement.

2. A combination thermal actuator and fusible link comprising a memory metal spring adapted to change its shape on a rise in temperature, a fusible element or fusible material adapted to melt at a predetermined higher temperature, and an anti-vibration locking device.

3. A combination thermal actuator and fusible link comprising a memory metal spring adapted to change its shape on a rise in temperature, and a fusible element or fusible material adapted to melt at a predetermined higher temperature, the thermal actuator and fusible link being arranged in a unitary structure which can be mounted outside a duct containing a fire and/or smoke damper with which the actuator/link is associated.

4. A combination thermal actuator and fusible link in the form of a cartridge which can be mounted at one end on

the blade actuator of a fire and/or smoke damper, the actuator/link comprising a memory metal spring adapted to change its shape on a rise in temperature and a fusible element or fusible material adapted to melt at a predetermined higher temperature.

5. An actuator/link according to any preceding claim comprising a fusible link spindle or shaft which carries a fusible link latching bush, the bush and the spindle being soldered together so that relative movement between them is prevented until such time as the solder melts due to a rise in temperature.

6. An actuator/link according to claim 5 having a memory metal spring which surrounds a portion of the spindle or shaft.

7. An actuator/link according to claim 6 having a thermal actuator plunger mounted for limited axial movement on the said portion of the shaft or spindle, the plunger being axially separated from the fusible link latching bush by a thermal actuator plunger bias spring.

8. An actuator/link according to any one of claims 5-7 having two release/stop latch springs arranged on opposite sides of the plunger or shaft.

9. An actuator/link according to claim 8, in which a yoke extends forwards from the rear portion of the shaft or spindle so that forward tongues or lugs on the yoke enter respective slits on an anti-vibration cup to which the

tongues or lugs are secured.

10. An actuator/link according to claim 8, in which a split barrel extends forwards from the rear portion of the shaft or spindle and is secured to an anti-vibration cup.

11. An actuator/link according to claim 10, in which a window is provided in each half section of the barrel to permit a through-flow of air and to enable a visual inspection to be made of the memory metal spring.

12. An actuator/link according to any one of claims 5-11, in which the forward operation of the spindle or shaft is provided with a screw-thread to permit it to be screwed into the blade actuator of a fire and/or smoke damper.

13. An actuator/link according to any one of claims 5-11 having a nut and a shaft extension to permit the actuator/link to be mounted on the blade actuator of a fire and/or smoke damper.

14. An actuator/link substantially as described herein with reference to Figures 1-6, Figures 7-12, Figures 13-17 or Figures 18-23 of the accompanying drawings.

15. A blade actuator for use with a fire and/or smoke damper having an actuator/link as claimed in any preceding claim attached to it or mounted on it.

16. A fire and/or smoke damper having a blade actuator as claimed in claim 15.

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